FAA-E-2221b
January 29, 1973

Superseding
FAA-E-2221a, 8/28/70

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

ILS MARKER BEACON STATION

1. SCOPE AND CLASSIFICATION

1.1 Scope. The equipment specified herein is a 2.5 watt marker beacon transmitter station operating on a frequency of 75 megahertz designed to be mounted outdoor on a wood pole or housed indoors. The equipment includes one transmitter, one monitor, a power supply operating simultaneously as a battery charger; an antenna with monitor pick-up; and a shelter. This specification also covers optional dual transmitters and automatic change-over units.. All active electronic devices are-solid-state.

1.2 Classification. The marker beacon transmitting station will consist of one of the following types:

Type I Pole mounted marker beacon station
Type II Shelter marker beacon station

The quantity and the type of marker beacon stations to be provided will be stated in the contract schedule.

2. APPLICABLE DOCUMENTS

2.1 FAA Specifications. The following FAA specifications and standards of the issues specified in invitations for bids or requests for proposals, form a part of this specification:

FAA-C-1217	Electrical Work, Interior
FAA-G-2100 Supplement 4	Electronic Equipment, General Requirements FAA List of Applicable Documents
FAA-G-2100/1	Electronic Equipment, General Requirements; Part 1, Basic Requirements for all equipments
FAA-G-2100/3	Part 3, Requirements for Equipment Employing Semiconductor Devices
FAA-G-2100/4	Part 4, Requirements for Equipment Employing Printed Wiring Techniques
FAA-G-2100/5	Part 5, Requirements for Equipment Employing Microelectronic Devices
FAA-D-2494/1	Instruction Books Manuscripts Technical; Equipment and Systems, Requirements, Part 1 - Preparation of Manuscript
FAA-D-2494/2	Preparation of Manuscript Copy and Reproducible Artwork

2.1.1 FAA Standards

FAA-STD-002	Engineering Drawings
FAA-STD-003	Paint Systems for Structures
FAA-STD-005	Preparation of Specification Documents
FAA-STD-013	Quality Control Program Requirements

2.2 Military and Federal Publication. The following Military and Federal Publications of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military Specifications

MIL-F-16081	Fans, Ventilating, Propeller
MIL-E-17555	Electronic and Electrical Equipment, and Associated Repairs Parts, Preparation for Delivery of

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3.8.3 Modulation frequency. The transmitter shall include built-in tone generating and modulating facilities so that it can be modulated by each of the following audio tone frequencies, as selected (functional reference names are included):

400 Hz (Outer Marker)

1300 Hz (Middle Marker)

3000 Hz (Inner Marker)

3000 Hz (Back Course Marker)

Choice of the modulation frequency and the corresponding keying rate (3.9) shall be made by jumper connections on the appropriate printed wiring board(s) or conveniently accessible terminal board on the transmitter chassis.

3.8.3.1 Optional configuration. In lieu of the "built-in" characteristics of the facilities as described above, the equipment may, at the option of the Contractor, be designed to provide individual audio-keyer printed wiring boards for each of the functions described above. Any one board as selected by the government, when inserted in the appropriate circuit receptacle, shall provide the required performance. Storage space for the remaining boards not in use shall be provided within the equipment. Accordingly, this technique will obviate the requirement stated above for jumper connections to select modulation frequency and keying rate.

3.8.4 Modulation frequency tolerance. Each modulation frequency shall remain within the tolerances listed below when measured under the services conditions:

(a) 400 Hz (Outer Marker) $\pm$ 1 Hz

(b) 1300 Hz (Middle Marker) $\pm$ 3 Hz

(c) 3000 Hz (Inner Marker) $\pm$ 8 Hz

3.8.5 Modulation harmonic distortion. The total harmonic distortion in the demodulated output shall not exceed 8 percent with rated power output and 95 percent modulation.

3.9 Identification Keyer. The transmitter shall include solid-state electronic keying facilities that shall key the following audio tones without interruption of the carrier in each of the modes described below, with selection of the keying mode as described in 3.8.3 or 3.8.3.1.

(a) The outer marker audio modulation frequency (400 Hz) shall be keyed to provide a continuous series of dashes.

(b) The middle marker audio modulation frequency (1300 Hz) shall be keyed to provide a continuous series of alternate dots and dashes.

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system. The contractor shall also layout, design and fabricate the shelter to house all the components of the Type II marker station (excluding the antenna) and provide in addition space and power circuits for the addition of a compass locator transmitter (not furnished under this specification) and a workbench (to be supplied by contractor). The shelter and installed electronic equipment shall be designed for transportation from the equipment contractor's plant to the installation site and future transportation to different locations by the government.

3.15.3.1 Appearance. The exterior surface of the type II shelter marker beacon station shall be insignia white, color 17875 of FED-STD-595. Painting of the exterior surfaces shall be in accordance with FAA-STD-003 unless otherwise indicated.

3.15.3.2 Shape and Size. The Type II marker shelter shall be square in shape with the nominal exterior dimensions 6 ft - 0 inches by 6 ft - 0 inches. The wall thickness shall not exceed 5 inches. The minimum interior floor to ceiling height shall be 8 ft - 0 inch or 2 ft - 0 inch higher than equipment racks, whichever is the greater. The minimum interior head clearance (personnel safety) shall be 6 ft -9 inches in work areas.

3.15.3.3 Type II Marker Design criteria. The shelters shall be designed in accordance with the Uniform Building Code, Volume 1, current edition. This specification shall take precedence over the Uniform Building Code in event of conflict. The shelters shall be designed for a 20 year useful life withstanding the environment and service specified herein. The shelters shall be designed to withstand subsequent relocations, with all equipment in place, after initial field installation. The shelters shall be in accordance with all applicable requirements of Department of Labor Standard Title 29, Chapter XVII, Part 1910. The shelter, including roof, shall be designed and connected to the floor structure so the structure as a whole shall be capable of resisting twice the overturning moment resulting from wind uplift forces stipulated with the floor structure anchored to the foundation. The structural design shall incorporate all requirements for openings and support made necessary by equipment installed (including the future installation of compass locator equipment) on or through the structure. Floor, wall, and roof surface materials shall not be used for support, restraint, or alignment of installed equipment. The floor system shall be designed to support a uniform live load, as determined by the contractor, based upon the maximum loads imposed by the equipment and personnel to be supported, recognizing that electronic equipment may be relocated within the shelter in the future. In no case shall the floor be designed for less than 40 p.s.f. The floor system deflections due to live loads shall not exceed 1/360 of the spans, The ceiling shall be designed to support a uniform live load, as determined by the contractor, based upon the maximum loads imposed by equipment mounted or suspended from the ceiling. Design loads shall be based on the service conditions. The shelter shall be designed to withstand the dynamic loads resulting from sudden starting and stopping during transportation and movement over bumpy roads. The dead load of the shelter and all installed equipment shall be included in the dynamic design. The minimum vertical shock loading shall be 3g and the minimum lateral and longitudinal shock loads shall be 1g. Shock loads shall be considered to have a minimum frequency of 20 Hz.

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3.15.3.1 Appearance. The exterior surface of the type II shelter marker beacon station shall be insignia white, color 17875 of FED-STD-595. Painting of the exterior surfaces shall be in accordance with FAA-STD-003 unless otherwise indicated.

3.15.3.2 Shape and Size. The Type II marker shelter shall be square in shape with the nominal exterior dimensions 6 ft - 0 inches by 6 ft - 0 inches. The wall thickness shall not exceed 5 inches. The minimum interior floor to ceiling height shall be 8 ft - 0 inch or 2 ft - 0 inch higher than equipment racks, whichever is the greater. The minimum interior head clearance (personnel safety) shall be 6 ft -9 inches in work areas.

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system. The contractor shall also layout, design and fabricate the shelter to house all the components of the Type II marker station (excluding the antenna) and provide in addition space and power circuits for the addition of a compass locator transmitter (not furnished under this specification) and a workbench (to be supplied by contractor). The shelter and installed electronic equipment shall be designed for transportation from the equipment contractor's plant to the installation site and future transportation to different locations by the government.

3.15.3.1 Appearance. The exterior surface of the type II shelter marker beacon station shall be insignia white, color 17875 of FED-STD-595. Painting of the exterior surfaces shall be in accordance with FAA-STD-003 unless otherwise indicated.

3.15.3.2 Shape and Size. The Type II marker shelter shall be square in shape with the nominal exterior dimensions 6 ft - 0 inches by 6 ft - 0 inches. The wall thickness shall not exceed 5 inches. The minimum interior floor to ceiling height shall be 8 ft - 0 inch or 2 ft - 0 inch higher than equipment racks, whichever is the greater. The minimum interior head clearance (personnel safety) shall be 6 ft -9 inches in work areas.

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3.15.3.1 Appearance. The exterior surface of the type II shelter marker beacon station shall be insignia white, color 17875 of FED-STD-595. Painting of the exterior surfaces shall be in accordance with FAA-STD-003 unless otherwise indicated.

3.15.3.2 Shape and Size. The Type II marker shelter shall be square in shape with the nominal exterior dimensions 6 ft - 0 inches by 6 ft - 0 inches. The wall thickness shall not exceed 5 inches. The minimum interior floor to ceiling height shall be 8 ft - 0 inch or 2 ft - 0 inch higher than equipment racks, whichever is the greater. The minimum interior head clearance (personnel safety) shall be 6 ft -9 inches in work areas.

3.15.3.3 Type II Marker Design criteria. The shelters shall be designed in accordance with the Uniform Building Code, Volume 1, current edition. This specification shall take precedence over the Uniform Building Code in event of conflict. The shelters shall be designed for a 20 year useful life withstanding the environment and service specified herein. The shelters shall be designed to withstand subsequent relocations, with all equipment in place, after initial field installation. The shelters shall be in accordance with all applicable requirements of Department of Labor Standard Title 29, Chapter XVII, Part 1910. The shelter, including roof, shall be designed and connected to the floor structure so the structure as a whole shall be capable of resisting twice the overturning moment resulting from wind uplift forces stipulated with the floor structure anchored to the foundation. The structural design shall incorporate all requirements for openings and support made necessary by equipment installed (including the future installation of compass locator equipment) on or through the structure. Floor, wall, and roof surface materials shall not be used for support, restraint, or alignment of installed equipment. The floor system shall be designed to support a uniform live load, as determined by the contractor, based upon the maximum loads imposed by the equipment and personnel to be supported, recognizing that electronic equipment may be relocated within the shelter in the future. In no case shall the floor be designed for less than 40 p.s.f. The floor system deflections due to live loads shall not exceed 1/360 of the spans, The ceiling shall be designed to support a uniform live load, as determined by the contractor, based upon the maximum loads imposed by equipment mounted or suspended from the ceiling. Design loads shall be based on the service conditions. The shelter shall be designed to withstand the dynamic loads resulting from sudden starting and stopping during transportation and movement over bumpy roads. The dead load of the shelter and all installed equipment shall be included in the dynamic design. The minimum vertical shock loading shall be 3g and the minimum lateral and longitudinal shock loads shall be 1g. Shock loads shall be considered to have a minimum frequency of 20 Hz.

system. The contractor shall also layout, design and fabricate the shelter to house all the components of the Type II marker station (excluding the antenna) and provide in addition space and power circuits for the addition of a compass locator transmitter (not furnished under this specification) and a workbench (to be supplied by contractor). The shelter and installed electronic equipment shall be designed for transportation from the equipment contractor's plant to the installation site and future transportation to different locations by the government.

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AC line voltage varied over the service conditions range. The charger shall be capable of continuous operation at rated current over the service conditions range of temperature and humidity. The charger shall incorporate adjustable float and equalizing voltage potentiometer(s). Float voltage shall be adjustable over a range of 12.4 to 13.4 volts or 24.8 to 26.8 volts utilizing the middle 60 percent to 90 percent of the total control travel under normal test conditions. Equalize voltage shall be automatically 1.1 + 0.02 or 2.2± 0.04 volts higher than the float voltage setting or shall be separately adjustable over a range of 13.5 to 14.5 or 27.0 to 29.0 volts utilizing the middle 60 percent to 90 percent of the total control travel under normal test conditions. The charger shall be designed to recharge a fully discharged battery bank without overlapping or actuating AC or DC circuit protection devices. Circuit protection devices shall not be over-loaded or actuated under any external circuit condition, including short circuit at the charger output terminals.

3.21.1 AC switch and indicator light. A DPST toggle switch and green indicator light (1-3.16.5.1 of FAA-G-2100/1) shall be provided for the control and indication of primary AC power to the battery charger-power supply.

3.21.2 Power consumption. Power consumption from the AC line shall not exceed 200 watts with the transmitter operating at rated carrier power and the battery charger-power supply providing equalizing charge to the battery.

3.21.3 Loss of AC power. Loss of AC power shall not result in interruption of transmitter operation (provided that batteries are installed). See also 3.23.

3.21.4 Carrier power output stability with AC input variation. After initial adjustment of the transmitter carrier power to 2.5 watt output, the carrier power shall not vary more than ± 10 percent when the AC line voltage is varied over the service conditions range.

3.22 Circuit protection. In addition to the circuit protection requirements of 1-3.7, FAA-G-2100/1, DC circuit protection shall also be provided. A fuse shall be provided to protect components of the transmitter. A second fuse or, at the Contractor's option, a series resistor shall be provided to limit the DC current applied to the monitor control line to 1.0 ampere.

3.23 Optional dual transmitter.. When dual transmitter stations are so specified in the contract schedule, two complete transmitter units (as defined in 3.1) and an antenna transfer unit shall be housed in the transmitter shelter of 3.15. Automatic changeover shall be provided to turnoff No. 1 transmitter and monitor, and turn-on No. 2 transmitter and monitor when No. 1 monitor alarms. Transfer time shall not exceed 1 second after alarm indication on monitor No. 1. When monitor No. 2 alarms, the station shall shutdown. Restart from shutdown condition shall be accomplished by manual reset. When batteries are not installed and AC power is removed, the transmitter in operation prior to the loss of power shall be restored to normal operation upon subsequent restoration of power.

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5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

5.4 Marking. Each package and shipping container shall be durably and legibly marker with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.

5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

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Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.

5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

5.4 Marking. Each package and shipping container shall be durably and legibly marker with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.

5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

5.4 Marking. Each package and shipping container shall be durably and legibly marker with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.

5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

5.4 Marking. Each package and shipping container shall be durably and legibly marker with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.

5.2.2 Type II. Equipment. Preservation and packaging to items to be delivered in the shelter shall be in accordance with paragraph 3.7.1.2 (Level C) of MIL-E-17555 and packing of these items shall be in accordance with paragraph 3.7.2.2 (Level C) of MIL-E-17555. Items to be delivered separate from the shelter shall be in accordance specification (MIL-E-17555, Level A, Methods II).

5.3 Packings. Packing of items to be delivered for the Type I, and the items that are to be delivered separate from the shelter for the Type II shall be in accordance with specification MIL-E-17555, Level B. No more than one set of equipment and associated items shall be packed in each shipping container.

5.4 Marking. Each package and shipping container shall be durably and legibly marker with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 None.